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Oceans and the law of the sea

Oceans and the law of the sea

Report of the Secretary-General

Summary

The present report has been prepared pursuant to paragraph 284 of General Assembly resolution 68/70 of 9 December 2013, with a view to facilitating discussions on the topic of focus at the fifteenth meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea, on the theme entitled "The role of seafood in global food security". It constitutes the first part of the report of the Secretary-General on developments and issues relating to ocean affairs and the law of the sea for consideration by the Assembly at its sixty-ninth session. The report is also being submitted to the States Parties to the United Nations Convention on the Law of the Sea, pursuant to article 319 of the Convention. In the light of the multifaceted nature of the topic being covered and the page limitations established by the General Assembly, the report does not purport to provide an exhaustive synthesis of available information.

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I. Introduction

1. In paragraph 274 of its resolution 68/70 of 9 December 2013, the General Assembly decided that, in its deliberations on the report of the Secretary-General on oceans and the law of the sea, the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (the Informal Consultative Process) would focus its discussions at its fifteenth meeting on the role of seafood in global food security. The present report addresses that topic.

2. Food security and nutrition has become a pressing global challenge underscoring the need for sustainable food sources. Seafood already plays an important, albeit perhaps underrecognized, role in global food security as a key source of food and nutrition, as an input into the food production chain and as a source of revenue for individuals and States. The future role of seafood in global food security, however, faces considerable pressures, including overexploitation and other unsustainable practices in seafood exploitation, as well as other stressors on the marine environment, such as habitat loss, pollution, climate change, ocean acidification and invasive alien species, which affect the health, productivity and resilience of marine ecosystems.

3. The present report highlights the current role of seafood in global food security as well as the pressures thereon. It also draws attention to activities and initiatives undertaken with a view to ensuring the continued role of seafood in global food security and highlights opportunities for, and challenges to, the future role of seafood in global food security.

4. The Secretary-General wishes to express his appreciation to the organizations and bodies that contributed to the present report, namely, the European Union and the secretariats of the Convention on Biological Diversity and the Convention on the Conservation of Antarctic Marine Living Resources; the Council of Europe; the Department of Economic and Social Affairs of the Secretariat; the Food and Agriculture Organization of the United Nations (FAO); the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO); the International Atomic Energy Agency (IAEA); the International Commission for the Conservation of Atlantic Tunas; the International Council for the Exploration of the Sea; the International Coral Reef Initiative; the International Labour Organization (ILO); the North Atlantic Salmon Conservation Organization; the North East Atlantic Fisheries Commission; the North Pacific Anadromous Fish Commission; the Office for Disarmament Affairs of the Secretariat; the Parliamentary Assembly of the Mediterranean; the Partnerships in Environmental Management for the Seas of East Asia; the South Pacific Regional Fisheries Management Organization; the United Nations Industrial Development Organization (UNIDO); the United Nations University Fisheries Training Programme; and the World Meteorological Organization (WMO).[1] The report also draws on information from a number of other sources, but does not purport to provide an exhaustive synthesis of available information.

[1] Contributions authorized by the authors to be posted online are available at www.un.org/Depts/los/general_assembly/general_assembly_reports.htm.

II. The current role of seafood in global food security

A. Background

5. Despite the commitment of the international community in the United Nations Millennium Declaration (General Assembly resolution 55/2) to reduce by half the proportion of people who suffer from hunger by 2015, persistent hunger and malnutrition remain the norm for close to 842 million people around the world suffering from hunger, approximately 2 billion suffering from micronutrient deficiencies[2] and more than 200 million children under five years of age suffering from malnutrition.[3] During the global food crisis of 2007-2008, a rapid rise in global staple food prices led to increased food insecurity and riots around the world.[4] The close connection between food security and economic growth and social progress as well as with political stability and peace has been underlined.[5]

6. According to the Declaration of the World Summit on Food Security, food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. The four pillars of food security are availability, access, utilization and stability. The nutritional dimension is integral to the concept of food security.[6]

7. Food security is both a requirement for achieving sustainable development as well as one of the goals of sustainable development. Strong interdependencies exist between food security and nutrition and many other parts of the broader sustainable development agenda.[7] Food security also has a human rights dimension and the right to adequate food has been recognized in international human rights instruments.[8]

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[2] World Health Organization, World Food Programme and United Nations Children's Fund, "Preventing and controlling micronutrient deficiencies in populations affected by an emergency" (Geneva, World Health Organization, 2007). Available from www.who.int/nutrition/publications/WHO_WFP_UNICEFstatement.pdf. According to the 2013 Fact Sheet on the Millennium Development Goals, "with concerted action by national Governments and international partners, the hunger target can be achieved" (see www.un.org/millenniumgoals/pdf/Goal_1_fs.pdf).

[3] Food and Agriculture Organization of the United Nations (FAO), Committee on World Food Security, Global Strategic Framework for Food Security and Nutrition (CFS 2012/39/5 Add.1/Rev.1, para. 1); FAO, International Fund for Agricultural Development and World Food Programme, *The State of Food Insecurity in the World 2013: The Multiple Dimensions of Food Security* (Rome, FAO, 2013).

[4] Edward H. Allison, "Aquaculture, fisheries, poverty and food security", Working Paper 2011-65 (WorldFish Center, 2011), p. 13. Available from http://aquaticcommons.org/7517/1/WF_2971.pdf.

[5] Joint Statement on Global Food Security, adopted in L'Aquila, Italy, on 10 July 2009 (www.g8italia2009.it/static/G8_Allegato/LAquila_Joint_Statement_on_Global_Food_Security%5B1%5D,0.pdf).

[6] Declaration of the World Summit on Food Security (Food and Agriculture Organization of the United Nations, document WSFS 2009/2).

[7] See "TST issues brief: food security and nutrition", available from http://sustainabledevelopment.un.org/content/documents/1804tstissuesfood.pdf.

[8] Interim report of the Special Rapporteur on the right to food (A/68/288, annex, paras. 1-3).

8. As the role of seafood in global food security gains recognition, the issue is being addressed by a growing number of forums, including the Committee on World Food Security.[9] In the outcome document of the United Nations Conference on Sustainable Development, held in Rio de Janeiro, Brazil, from 20 to 22 June 2012, entitled "The future we want", world leaders reaffirmed their commitments regarding the right of everyone to have access to safe, sufficient and nutritious food, consistent with the right to adequate food and the fundamental right of everyone to be free from hunger. These leaders acknowledged that food security and nutrition had become a pressing global challenge and, in that regard, further reaffirmed their commitment to enhancing food security and access to adequate, safe and nutritious food for present and future generations. They also stressed the crucial role of healthy marine ecosystems, sustainable fisheries and sustainable aquaculture for food security and nutrition and in providing for the livelihoods of millions of people.[10]

9. The present section highlights the current role of seafood in global food security both directly, as a source of food and nutrition (sect. B.1), and indirectly, as an input into food production (sect. B.2) or as a source of revenue (sect. B.3). It also underscores how pressures on the sustainable exploitation of seafood and on the marine environment affect that role. Inland fisheries are not addressed in the present report, but it is noted that their contribution to global food security is closely related to that of seafood.

B. How seafood contributes to global food security

1. Seafood as food

10. For the purposes of the present report, seafood is considered to include all marine living resources used for food, including fish, shellfish, crustaceans, marine mammals, sea turtles and algae.[11] This definition promotes a holistic view of the contribution of seafood to global food security. Due to space limitations, however, the present report will focus primarily on the contribution of marine living resources to global food security, in particular in the context of fisheries and aquaculture.

11. In order to meet the requirements of the four pillars of food security (see para. 6 above), it is important for seafood to have nutritional value (utilization) and for it to be available in sufficient quantities and on a consistent basis (availability). Individuals should be able to regularly acquire adequate quantities of seafood

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[9] For example, later in 2014, the Committee on World Food Security is expected to consider a report of its High-level Panel of Experts on Food Security and Nutrition on the topic "The role of sustainable fisheries and aquaculture for food security and nutrition" (www.fao.org/cfs/cfs-hlpe/en). The International Coalition of Fisheries Associations has also initiated work on this topic.

[10] General Assembly resolution 66/288, annex, paras. 108 and 113.

[11] Popular definitions of seafood differ, e.g., "Food obtained from the sea; fish, crustacea, etc., used as food" (www.oed.com); "Fish and shellfish that live in the ocean and are used for food" (www.m-w.com); "Seafood is any sea animal or seaweed that is served as food or is suitable for eating, particularly seawater animals, such as fish and shellfish (including mollusks and crustaceans)" (http://seafood.askdefine.com); "animals from the sea that can be eaten, especially fish or sea creatures with shells" (http://dictionary.cambridge.org/us/dictionary/british/seafood?q=seafood).

(access), and the supply of seafood should be resistant to spikes in price or temporary shortages (stability).[12]

12. *Utilization and nutritional value*. Seafood plays an important role in human nutrition, in particular as a key source of protein and essential micronutrients. Fish contributes about 17 per cent to the world's animal protein intake, and is the main source of animal protein along with essential micronutrients and fatty acids for 3 billion people.[13] Populations in Africa and Asia rely even more on fish for their intake of animal proteins, and this contribution can reach up to 40 per cent or more in some small island developing States.[14] According to one estimate, rural inhabitants of the Solomon Islands rely on fish and fish products for 94 per cent of their animal protein.[15] Notably, seafood contributes almost a quarter of animal proteins consumed by people in low-income food-deficit countries.[16]

13. Although fish plays an extremely important role in the supply of protein worldwide, it has been considered more important as a source of micronutrients and lipids.[17] It is estimated that in excess of 2 billion people, especially in developing countries, are undernourished due to a lack of essential vitamins and minerals often contained in fish.[18] These deficiencies are believed to be "especially important at key stages of human life (pregnancy, breastfeeding, childhood)".[19] Seafood plays an important part in the diet of many indigenous peoples, for example, the diet of the Yup'ik Eskimos contains 20 times more omega-3 fats from fish than the diet of the people in the rest of the United States of America.[20]

14. Important micronutrients provided by fish consumption include minerals, certain vitamins and omega-3 fatty acids,[21] as well as lysine, an essential amino acid.[22] Regular consumption (one to three times per week) of fish can reduce the risk of various diseases and disorders, particularly cardiovascular disease. It can also benefit brain health and development and relieve inflammatory conditions, and may help reduce the risk of premature birth.[23]

15. Different types of seafood may have different nutritional value. For example, it has been suggested that "large farmed freshwater fish often possess micronutrient and lipid profiles inferior to those of small species derived from marine and inland capture fisheries".[24] In particular, levels of eicosapentaenoic acid and

[12] See https://www.wfp.org/node/359289.

[13] FAO, Committee on Fisheries, Sub-Committee on Aquaculture, "Global Aquaculture Advancement Partnership (GAAP) Programme" (FAO document COFI:AQ/2013/SBD.2), and contribution of FAO.

[14] Contribution of FAO.

[15] Secretariat of the Pacific Community, "Fish and food security", Policy Brief 1/2008. Available from www.spc.int/coastfish/en/publications/brochures/policy-briefs.html.

[16] For a definition of low-income food-deficit countries, see www.fao.org/countryprofiles/lifdc/en/.

[17] See Allison, note 4 above, p. 7.

[18] Ibid.

[19] Ibid.

[20] See www.sciencedaily.com/releases/2011/03/110324153712.htm.

[21] See for example, Charles R. Santerre, "The risks and benefits of farmed fish", *Journal of the World Aquaculture Society*, vol. 41, No. 2 (2010).

[22] See Allison, "Aquaculture, fisheries, poverty and food security", p. 21.

[23] Contribution of the European Union.

[24] B. Belton and S. H. Thilsted, "Fisheries in transition: food and nutrition security implications for the global South", *Global Food Security*, vol. 3, No. 1 (2014), pp. 59-66.

docosahexaenoic acid may be lower in certain types of farmed species.[25] However, many of the factors that affect the quality and nutritional value of fish can be monitored and controlled during farming.[26]

16. Other types of seafood also serve as important sources of protein and micronutrients. For example, various types of seaweed contain protein, dietary fibre, vitamins, minerals and amino acids.[27] Seaweed is used for direct human consumption and hydrocolloids like agar, alginate and carrageenan have been extracted from seaweed and used as thickening and gelling agents in food products. Seaweed meal is also used in animal and fish feed.

17. Crustaceans and shellfish similarly provide important nutritional benefits.[28] While not as widely consumed, for a variety of reasons, marine mammals can also provide an important source of nutrition, in particular for certain groups of indigenous peoples.[29] Since 1990, people in at least 114 States have consumed one or more of at least 87 marine mammal species. These statistics include animals killed deliberately, or unintentionally as by-catch or strandings.[30] A wide range of concerns have been expressed, however, over the consumption of marine mammals as food, arising from questions of sustainability and food safety[31] as well as cultural, religious and spiritual beliefs. Such concerns have, for example, led to support for an international moratorium on commercial whaling since 1986.[32] However, the food security needs of indigenous people are supported through catch limits set for aboriginal subsistence whaling.

18. Food safety can affect the nutritional value of seafood. If not properly produced, transported, stored or prepared, some types of seafood are prone to spoilage. Environmental factors, such as pollution and poor ecosystem health, may also affect the nutritional value of seafood, particularly through contamination. Food safety and environmental laws and regulations, effective quality control and consumer awareness can play an important role in minimizing the risks associated with the consumption of unsafe seafood.[33]

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[25] Albert G. J. Tacon and Marc Metian, "Fish matters: importance of aquatic foods in human nutrition and global food supply", *Reviews in Fisheries Science*, vol. 21, No. 1 (2013), pp. 28 and 35.

[26] FAO, Committee on Fisheries, Sub-Committee on Aquaculture, "The role of aquaculture in improving nutrition: opportunities and challenges" (FAO document COFI:AQ/VII/2013/7).

[27] Dennis J. McHugh, *A Guide to the Seaweed Industry*, FAO Technical Fisheries Paper No. 441 (Rome, FAO, 2003), pp. 73-89. Available from ftp://ftp.fao.org/docrep/fao/006/y4765e/y4765e00.pdf.

[28] See www.fda.gov/downloads/Food/IngredientsPackagingLabeling/LabelingNutrition/UCM169242.pdf.

[29] See http://iwc.int/aboriginal.

[30] Martin D. Robards and Randall R. Reeves, "The global extent and character of marine mammal consumption by humans: 1970-2009", *Biological Conservation*, vol. 144, No. 12 (2011), pp. 2770-2786.

[31] The cat parasite *Toxoplasma gondii*, which can cause blindness in people, has been identified in a number of marine mammals, including beluga in the western Arctic and sea otters. See "Parasite in cats killing sea otters" (www.csgc.ucsd.edu/NEWSROOM/NEWSRELEASES/2002/ParasitesKillingSeaOtters.html); "Cat parasite found in Arctic beluga" (www.bbc.com/news/science-environment-26197742).

[32] See http://iwc.int/commercial.

[33] FAO, *The State of World Fisheries and Aquaculture 2012* (Rome, 2012), pp. 158-164.

19. *Availability*. In 2012, global fish production amounted to approximately 157 million tons, with marine fisheries and aquaculture accounting for approximately 100 million tons.[34] With sustained growth in fish production and improved distribution channels, world fish food supply has grown substantially in the last five decades, with an average growth rate of 3.2 per cent per year in the period 1961-2009, outpacing the increase of 1.7 per cent per year in the world's population.[35]

20. While fish production from marine capture fisheries has been fairly stable in recent years (around 80 million tons in 2007-2012; see the table below), the increasing demand for fish and fishery products has been steadily met by a robust increase in aquaculture production. This growth has been estimated at an average 8.1 per cent yearly during the period 1970-2012.[36]

Global fish production and utilization, 2007-2012

(Millions of tons)

	2007	*2008*	*2009*	*2010*	*2011*	*2012 (estimated)*
A. Production						
Capture fisheries						
Inland	10.1	10.2	10.4	11.2	11.1	11.5
Marine	80.7	79.9	79.6	77.7	82.4	79.5
Subtotal	**90.7**	**90.1**	**90.0**	**89.0**	**93.5**	**91.0**
Aquaculture						
Inland	33.4	36.0	38.1	40.9	43.9	46.4
Marine	16.6	16.9	17.6	18.1	18.8	20.1
Subtotal	**49.9**	**52.9**	**55.7**	**59.0**	**62.7**	**66.5**
Total	**140.7**	**143.0**	**145.7**	**148.0**	**156.2**	**157.5**
B. Utilization						
Human consumption	117.4	120.8	123.8	128.1	132.3	135.4
Non-food uses	23.3	22.3	21.9	19.9	23.9	22.1
Population (billions)	6.7	6.8	6.8	6.9	7.0	7.1
Per capita food fish consumption (kilograms)	17.6	17.9	18.1	18.5	18.9	19.1

Source: FAO contribution.

21. In the past three decades, world food fish production of aquaculture has expanded by almost 12 times.[37] As a result, the average annual contribution of food fish from aquaculture for human consumption has increased sevenfold, from 6 per

[34] Contribution of FAO.
[35] FAO, note 33 above, p. 84.
[36] Contribution of FAO.
[37] FAO, note 33 above, p. 8.

cent in 1970 to 49 per cent in 2012.[38] It continues to be the fastest growing food production sector in the world at nearly 6.5 per cent a year.[39] Of this, 90 per cent is produced in developing countries, primarily from small-scale aquaculture.[40] According to a recent study by the World Bank, fish production has the potential to increase by 23.6 per cent between 2010 and 2030, principally through increases in aquaculture outputs.[41]

22. It has been projected that future fish supplies will be dominated by aquaculture systems because, among other reasons, feed conversion rates for many farmed fish are more efficient than those of land-based animal production, and aquaculture is an efficient user of water.[42]

23. Despite the relative stability of yields from capture fisheries and the increased yields from aquaculture in recent years, there are concerns regarding the future sustainability of current production levels. Overexploited stocks are less productive and prone to collapse. Rapid growth in aquaculture has been due in some regions to unsustainable practices that have negatively affected the marine environment upon which aquaculture yields depend. A wide variety of other anthropogenic pressures also continue to affect the marine environment and seafood yields (see sect. III below).

24. There is therefore concern that the availability of fish and fishery products may not be able to keep up with increased demand, as the world's population is expected to grow by 20.2 per cent from 2010 to 2030.[43] For example, in approximately one half of Pacific island countries and territories, sustainable production is not expected to meet future needs based on predicted population growth and estimate sustainable catches.[44]

25. *Access*. There are significant regional disparities in access to seafood. Of the 126 million tons available for human consumption in 2009, fish consumption was lowest in Africa (9.1 million tons, or 9.1 kg per capita), while Asia accounted for two thirds of total consumption. The corresponding per capita fish consumption figures for Oceania, North America, Europe and Latin America and the Caribbean were 24.6 kg, 24.1 kg, 22.0 kg and 9.9 kg, respectively.[45]

26. The supply of fish in Africa has been described as being "in crisis". Per capita consumption in sub-Saharan Africa is the lowest in all regions and it is the only part of the world where consumption is declining, principally owing to the levelling off in capture fish production and the increasing population. In order to simply maintain the current level of per capita supply of fish in sub-Saharan Africa (6.6 kg/year) up to 2015, fish production (capture fisheries and aquaculture) has to increase by 27.7 per cent over this period.[46] Supply is also an issue in the least developed

[38] Contribution of FAO.

[39] FAO, note 13 above, p. 3.

[40] Contribution of the United Nations University.

[41] World Bank, *Fish to 2030: Prospects for Fisheries and Aquaculture* (Washington, D.C., 2013), p. 44.

[42] World Bank, "Strategic vision for fisheries and aquaculture" (Washington, D.C., 2011).

[43] World Bank, *Fish to 2030: Prospects for Fisheries and Aquaculture*.

[44] Secretariat of the Pacific Community, "Fish and food security".

[45] FAO, note 33 above, pp. 3-4.

[46] C. Béné and S. Heck, "Fish and food security in Africa", *NAGA — the WorldFish Center Quarterly*, vol. 28, Nos. 3 and 4 (2005), p. 10.

countries of South and South-East Asia and the small island developing States of the Pacific region.[47]

27. Some access gaps are alleviated by trade in seafood and seafood products. Fish and other types of seafood are among the most traded food commodities. A sizeable share of fish consumed in developed countries consists of imports and, owing to steady demand and declining domestic fishery production (down 10 per cent in the period 2000-2010), their dependence on imports, in particular from developing countries, is projected to grow in coming years.[48] However, some concerns have also been expressed that, while it may bring economic benefits to exporting countries, trade in seafood can reduce access of the local populations in developing countries where the fish is caught, including by limiting the fish available to small-scale and artisanal fisheries.[49]

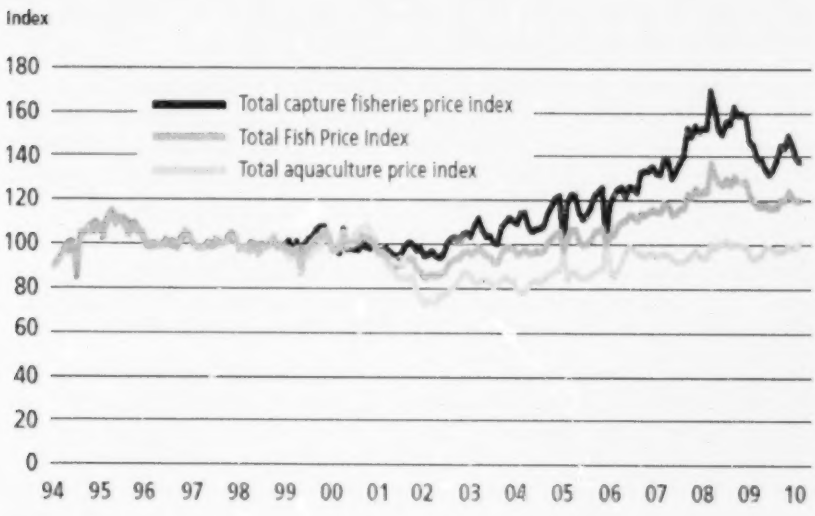
28. Transportability is also a key factor in access to seafood. Fish is very versatile as it can be processed into a wide array of products to increase its economic value and improve its transportability and durability. It is generally distributed in live, fresh, chilled, frozen, heat-treated, fermented, dried, smoked, salted, pickled, boiled, fried, freeze-dried, minced, powdered or canned form, or as a combination of two or more of these forms.[50] The available processing methods vary considerably, even within countries, and may affect access to fish.[51]

29. *Stability*. Although the global supply of fish from fisheries and aquaculture has been relatively stable, price fluctuations can occur in line with other food sources. During the global food crisis of 2007-2008, fisheries products rose in value, according to the FAO Fish Price Index (see figure I). The rise appeared to be more pronounced in the capture fisheries sector, where fuel costs for fishing vessels are a major input.[52]

30. Local seafood stability may also be subject to fluctuations based on severe and recurring weather events (including El Niño), disease and pollution incidents. Stability in this regard, however, may counteract instability in land-based food sources caused by factors such as droughts and flooding. Disease outbreaks have cost the global aquaculture industry tens of billions of dollars over the last 20 years.[53]

[47] Allison, note 4 above, p. 6.
[48] FAO, note 33 above, pp. 3 and 4.
[49] Allison, note 4 above, pp. 34-38.
[50] FAO, note 33 above, p. 63.
[51] Ibid., pp. 63 and 64.
[52] Allison, "Aquaculture, fisheries, poverty and food security", p. 13.
[53] Contribution of FAO.

Figure I
Trends in the FAO Fish Price Index and underlying indices



Note: 1998–2000 = 100.

Source: FAO, *The State of World Fisheries and Aquaculture 2010* (Rome, 2010).

31. *Food safety and post-harvest losses*. Food safety more generally affects the stability of seafood availability and cost. Being highly perishable, fish needs timely harvesting and procurement, efficient transportation and advanced storage, processing and packaging facilities for its marketing. For example, in many parts of Africa, lack of infrastructure has led to post-harvest losses of greater than 30 per cent of the catch.[54] Specific requirements and preservation techniques are therefore needed in order to preserve the nutritional quality of seafood, extend its shelf life, minimize the activity of spoilage bacteria and avoid losses caused by poor handling.[55]

32. For example, artisanal fisheries can suffer from high post-harvest losses because of low investment, low-level technology, variability in supply and contamination, especially during rainy periods. Spoilage and contamination of artisanal fisheries catch can create a significant source of food insecurity or even a public health hazard.[56]

[54] Béné and Heck, note 46 above, p. 12.
[55] FAO, note 33 above, p. 63.
[56] Contribution of the United Nations University Fisheries Training Programme.

2. Seafood and seafood products in food production

33. In addition to serving as food, seafood also contributes to food security as a key input in the production of food. In particular, fishmeal and algae can be used in feed for marine and freshwater aquaculture, livestock and poultry, as well as in fertilizers used to grow crops. Fish oils can also be used in the manufacture of edible oils and fats, such as margarine.[57]

34. Fishmeal, the crude flour obtained after milling and drying fish, is produced from whole fish, fish remains or other fish by-products resulting from processing. Many different species are used for fishmeal and fish-oil production, in particular anchoveta. The volume of fishmeal and fish oil produced worldwide annually fluctuates in line with catches of these species.

35. Another increasingly important source of raw material for the production of fishmeal is the processing waste from commercial fish species used for human consumption.[58] In 2010, 15 million tons of the 148 million tons of fish supplied by capture fisheries and aquaculture was reduced to fishmeal and fish oil.[59]

36. Aquaculture remains the largest user of fishmeal and fish oil. Aquafeeds are generally used for feeding omnivorous fishes, carnivorous fishes and crustacean species. According to FAO estimates, in 2008, about 31.7 million tons (46.1 per cent of total global aquaculture production including aquatic plants) of farmed fish and crustaceans were feed-dependent, making up 81.2 per cent of global farmed fish and crustacean production.[60] The fishmeal used for these diets varied between 2 and 10 per cent, with the exception of those for tilapia and catfish in a few countries, where up to 25 per cent fishmeal use has been reported.[61]

37. While the total amounts of fishmeal and fish oil used in aquafeeds have grown, the use of fishmeal to feed land animals has decreased in recent years. However, the percentage of aquafeeds made up of fishmeal has also decreased as the costs of fishmeal have increased. Some alternative protein sources have been identified.[62] For example, algal products can be used to enhance the nutritional value of food and animal feed owing to their chemical composition and thus play a crucial role in aquaculture.[63]

3. Seafood as a source of revenue

38. Apart from being an important source of food, the seafood sector has also been an important provider of livelihoods and economic benefits to millions of people engaged in harvesting, culturing, processing and trading seafood. This is especially true for coastal communities in developing countries, where large sections of the population have limited opportunities for employment and fish trade is sometimes the only option open for earning a livelihood and improving the quality of lives.

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[57] See www.fao.org/wairdocs/tan/x5926e/x5926e01.htm.

[58] FAO, note 33 above, p. 65.

[59] Ibid., p. 13.

[60] Ibid., p. 172.

[61] Ibid., p. 13.

[62] Ibid., pp. 180-181.

[63] Mohammad R. Hasan and Rina Chakrabarti, *Use of Algae and Aquatic Macrophytes as Feed in Small-scale Aquaculture: A Review*, FAO Fisheries and Aquaculture Technical Paper, No. 531 (Rome, FAO, 2009).

39. Worldwide, around 56 million people are directly employed in fisheries and aquaculture and some 200 million along the value chain from harvesting to distribution. Thus the livelihoods of some 660 to 820 million people, representative of 9 to 12 per cent of the global population, are dependent on the sector.[64]

40. The value of the global fish trade exceeds the value of international trade in all other animal proteins combined.[65] Most trade is dependent on the labour of those who work on the world's merchant ships and commercial fishing vessels.[66] Trade in seafood, as well as the granting of fishing licenses to foreign fishing vessels, can also be an important source of revenue for developing coastal States. However, some concerns have been expressed regarding the fair distribution of benefits from international fisheries between coastal States, particularly small island developing States, and distant-water fishing nations.[67]

41. The value of the marine capture seafood production at the point of harvest is approximately 20 per cent of the $400 billion global food fish market.[68] In 2012, the value of international trade in seafood was about $129 billion, while preliminary data for 2013 pointed to further growth to $136 billion. Over 53 per cent of this trade originated in developing countries whose net trade income (exports minus imports), valued at $35 billion in 2012, is greater than the net trade income of the other agricultural commodities combined.[69]

42. It is estimated that, overall, women accounted for at least 15 per cent of all people directly engaged in the fisheries primary sector in 2010. As much as 60 per cent of seafood is marketed by women in Asia and West Africa. In Africa, 59 per cent of fishers (marine, inland and aquaculture) are women.[70] Commonly, in coastal artisanal fishing communities, women manage the smaller boats and canoes that go out fishing. Women are also involved in gathering shells, sea cucumbers and aquatic plants in the intertidal zone and contribute as entrepreneurs and provide labour before, during and after the catch in both artisanal and commercial fisheries.[71] By generating incomes for female workers, especially in fish processing and marketing,

[64] Contribution of FAO. The 1995 Kyoto Declaration and Plan of Action on the Sustainable Contribution of Fisheries to Food Security (E/CN.17/1996/29, annex) recognizes and appreciates the significant role marine and inland fisheries as well as aquaculture play in providing global food security both through food supplies and economic and social well-being. See also the contribution of the Intergovernmental Oceanographic Commission of UNESCO.

[65] World Bank, note 42 above.

[66] Contribution of the International Labour Organization. Fishing continues to be one, if not the most hazardous occupation in the world, resulting in over 24,000 deaths annually, mainly on board small fishing vessels. The Maritime Labour Convention, 2006, of the International Labour Organization, sets out comprehensive rights and protection at work for the world's more than 1.5 million seafarers, who are indispensable to the carriage of 90 per cent of international trade.

[67] See, e.g., statements of Palau and Kiribati at the 63rd meeting of the General Assembly at its sixty-eighth session (A/68/PV.63), pp. 6 and 11-12.

[68] The World Bank and FAO, *The Sunken Billions: The Economic Justification for Fisheries Reform* (Washington, D.C., World Bank, 2009). Available from http://go.worldbank.org/MGUTHSY7U0.

[69] Contribution of FAO.

[70] African Union, concept note for the Second Conference of African Ministers of Fisheries and Aquaculture, Entebbe, Uganda, 14-18 March 2014, p. 3. Available from www.africanfisheries.org/knowledge-output/second-conference-african-ministers-fisheries-and-aquaculture-camfa-ii-concept-note.

[71] FAO, note 33 above, pp. 46, 97 and 108-111.

mployment in aquaculture has enhanced the economic and social status of women in many places in developing countries, where more than 80 per cent of aquaculture output occurs.

43. However, pressures on the role of seafood in global food security are affecting the economic contribution of the seafood sector (see sect. III below). Recent studies have demonstrated that, as a result of overfishing, the difference between the potential and actual net economic benefits from marine fisheries is approximately $50 billion per year, equivalent to more than half the value of the global seafood trade. Thus, global marine capture fisheries are currently an underperforming global asset.[72]

44. Aquaculture has made important contributions to livelihoods, poverty alleviation, income generation, employment and trade, even though its potential has not yet been fully realized across all continents.[73] Mediterranean aquaculture, for example, which is a large and dynamic industry and plays an important social and economic role in the region, has grown substantially over recent years. Aquaculture can also provide opportunities to meet increased consumer demand for aquatic products, while reducing the dependence on often overexploited wild stocks.[74]

45. Global production of algae has been dominated by marine macroalgae, or seaweeds, grown in both marine and brackish waters. Aquatic algae production by volume increased at average annual rates of 9.5 per cent in the 1990s and 7.4 per cent in the 2000s — similar to the rates for farmed aquatic animals — with production increasing from 3.8 million tons in 1990 to 19 million tons in 2010. Cultivation has overshadowed production of algae collected from the wild, which accounted for only 4.5 per cent of total algae production in 2010. The total value of farmed aquatic algae in 2010 is estimated at $5.7 billion, while that for 2008 is now re-estimated at $4.4 billion.[75]

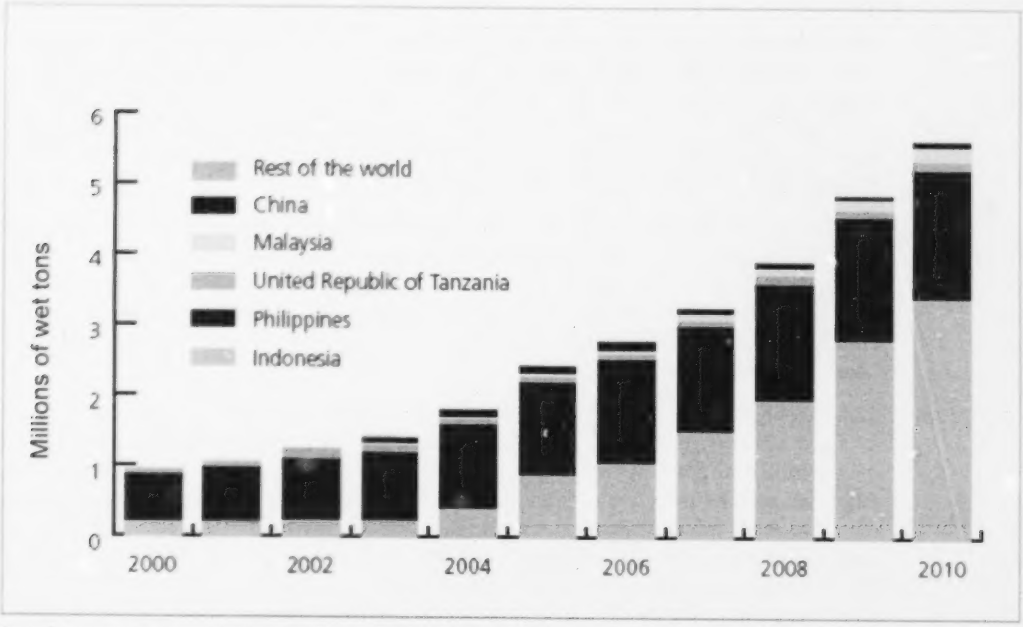
46. In sharp contrast to fish aquaculture, the cultivation of aquatic algae is practised in far fewer countries. Only 31 countries and territories are recorded as having engaged in algae farming production in 2010, and 99.6 per cent of global cultivated algae production comes from just eight countries in Asia and Africa.[76] China contributes 62.3 per cent of global production.

47. The total value of seaweed production was estimated by FAO in 2003 at $6 billion, of which $5 billion was the value of seaweed for human consumption. Carrageenan seaweed farming is a profitable activity with great potential (see figure II), especially for coastal communities with abundant labour and few alternative activities. Among other advantages, it has a short production cycle, low capital requirement and relatively simple farming technology. The price of carrageenan in the international market was generally stable in the first half of the 2000s but has increased rapidly since the mid-2000s and become more volatile. Seasonality, disease, inclement weather and competition are the biggest risk factors for seaweed farming. The seaweed value chain involves four stages: cultivation,

[72] World Bank and FAO, note 68 above.
[73] Ibid.
[74] Contribution of the Parliamentary Assembly of the Mediterranean.
[75] FAO, note 33 above, p. 40.
[76] Ibid., pp. 40-41.

post-harvest treatment, trading and processing,[77] with women playing an important role in seaweed farming. In India, for example, women were the first and primary adopters of seaweed farming which offered them an income.[78]

Figure II
World carrageenan seaweed farming production



Note: Carrageenan seaweeds under cultivation are *Kappaphycus* and *Eucheuma* seaweeds (Solieriaceae)
Source: FAO, *Social and Economic Dimensions of Carrageenan Seaweed Farming*, FAO Fisheries and Aquaculture Technical Paper, No. 580 (Rome, FAO, 2013), p. 9.

III. Pressures on the role of seafood in global food security

48. The seafood industry faces numerous pressures that affect the current, as well as the future, availability, access, utilization and stability of seafood in global food security, including ecosystem degradation and unsustainable exploitation and production practices. The capacity of marine ecosystems to support the production of seafood to meet the food security and nutritional needs of present and future generations is directly dependent on their health and resilience.

[77] FAO, *Social and Economic Dimensions of Carrageenan Seaweed Farming*, FAO Fisheries and Aquaculture Technical Paper, No. 580 (Rome, FAO, 2013), pp. 6-20.
[78] Ibid., pp. 42-43.

A. Unsustainable practices in the exploitation of seafood resources

49. A wide range of unsustainable practices in marine capture fisheries, including overfishing, illegal, unreported and unregulated fishing and destructive fishing, as well as unsustainable aquaculture practices, can affect the health of marine ecosystems and, therefore, the sustainability of resource exploitation and food security.

50. *Unsustainable exploitation of marine capture fisheries*. The share of marine fish stocks that are overexploited has increased during the last decades, from 10 per cent in 1970 to nearly one third in 2009. A further 52 per cent of the fish stocks are fully exploited.[79] Overexploitation may also have other detrimental impacts on marine ecosystems, including by upsetting predator-prey relationships, particularly in relation to associated and dependent species.[80]

51. Harmful subsidies create overcapacity in the fishing industry and have resulted in marine capture fisheries underperforming as a global asset (see para. 42 above). These subsidies, such as support for vessel construction and fuel tax waivers, reduce the real costs of fishing and enable unprofitable fishing to continue.[81] The cumulative economic loss to the global economy over the last three decades has been estimated to be in the order of 2 trillion dollars.[82]

52. Technological advances have the potential to contribute to the role of seafood in food security (see sect. IV.B.3 below). However, they have also accelerated overfishing and contributed to by-catch, destructive fishing practices and ecosystem degradation. The effectiveness and efficiency of fishing fleets has increased through technological improvements, including advanced hydraulic power applications, stronger materials for fishing gear, electronic aids to navigation, seafloor mapping, fish finding, gear deployment and communication.[83] Many of these technologies are also becoming more widely available, cheap and compact so they can be operated from smaller vessels.[84] The future modernization of small-scale and artisanal fisheries could increase their effectiveness and efficiency and further impact global fish catch.[85]

53. Discards are another contributor to overfishing. In its most recent global assessment of discards, FAO reports that 7.3 million tons of fish and other animals are captured and thrown away at sea annually. Much of the discarding is associated with the use of poorly selective fishing gears and often includes large quantities of juveniles of food fish species.[86]

54. Destructive fishing practices impair the ability of one or more key components of an ecosystem to provide essential ecosystem functions. While a few fishing

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[79] Contribution of FAO.

[80] S. M. Garcia and others, *The Ecosystem Approach to Fisheries: Issues, Terminology, Principles, Institutional Foundations, Implementation and Outlook*, FAO Fisheries Technical Paper, No. 443 (Rome, FAO, 2003), pp. 9-11.

[81] World Bank and FAO, *The Sunken Billions: The Economic Justification for Fisheries Reform*.

[82] Contribution of the European Union.

[83] P. Surronen and others, "Low impact and fuel efficient fishing — looking beyond the horizon", *Fisheries Research*, vols. 119-120, 2012, pp. 135-146.

[84] Ibid.

[85] See www.fao.org/fishery/topic/14753/en.

[86] Contribution of FAO.

practices are inherently destructive, such as the use of explosives and toxins, adverse impacts also occur from commonly used fishing gears, such as trawls, dredges, gillnets, pots, traps, hooks and lines.[87] The magnitude and extent of such impacts varies widely and depends to a large extent on the physical characteristics of the gear, the mechanics of its operation, where, when and how the gear is used and the extent of its use.[88] Synthetic pots, traps, gillnets and fish aggregating devices lost or discarded at sea can continue to catch and kill fish and other animals through a process known as ghost fishing.[89]

55. The practice of illegal, unreported and unregulated fishing, estimated globally at 11 to 26 million tons a year, further undermines efforts to manage fisheries sustainably and conserve marine biodiversity, often leading to the collapse of local fisheries.[90] This practice puts unsustainable pressure on fish stocks, marine wildlife and habitats, subverts labour standards and distorts markets.[91] Products derived from illegal, unreported and unregulated fishing enter local or overseas trade markets, thus undermining the local fisheries economy, depriving local communities of guaranteed food supplies and threatening the livelihoods of fishers and other fishery-sector stakeholders.[92]

56. Many factors contribute to illegal, unreported and unregulated fishing, including economic incentives that negate attempts to make fishing behaviour more responsible, as well as limited capacity or weak governance arrangements. Such fishing imposes significant economic costs on some of the poorest countries in the world, where dependency on fisheries for food, livelihoods and revenues is high, and undermines efforts by these countries to manage natural resources.[93]

57. *Unsustainable aquaculture practices*. Like any rapidly growing industry, aquaculture faces serious challenges. In many regions, ineffective governance and regulatory arrangements have failed to protect supporting ecosystems, with consequent impacts on marine resources and habitats. Aquaculture operations, for example, can negatively impact the local biophysical environment and thereby affect the food security of stakeholders competing with aquaculture for natural resources, such as capture fisheries.[94]

58. Capture fisheries and aquaculture may also compete with one another in relation to food security, with consequent trade-offs in relation to marine habitats, access to resources and fish utilization. Production from aquaculture may be economically profitable in the short term, but biologically wasteful processes may use more biomass to produce less.[95]

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[87] Ibid.
[88] Ibid.
[89] Ibid.
[90] Ibid.
[91] Contribution of the European Union.
[92] Contribution of FAO.
[93] Contribution of the European Union.
[94] Allison, note 4 above, pp. 43-44.
[95] Belton and Thilsted, note 24 above.

B. Other pressures on the marine environment

59. *Habitat alteration and destruction.* Much of the world's marine production originates from coastal ecosystems, such as wetlands, mangroves, coral reefs and sea-grass beds. These ecosystems play a major role in the life cycle of many marine organisms by providing breeding, nursery and feeding grounds.[96] However, owing to a range of factors, including unsustainable coastal area development, unsustainable tourism, unsustainable aquaculture and destructive fishing practices (see sect. II.A above), major marine ecosystems and habitats have been degraded or lost,[97] with resultant threats to fisheries productivity. For example, destruction of mangroves removes the nursery grounds of many fish species and can result in reduced productivity of fish stocks.[98]

60. *Pollution.* Pollution can have lasting effects on marine ecosystems. It originates from a number of marine and land-based sources, including riverine discharges, run-offs from industrial, agriculture and aquaculture operations, municipal wastewater, atmospheric deposition, dumping, accidents (e.g., oil spills), fishing operations, shipping and offshore installations. Marine pollution occurs in various forms, including heavy metals, persistent organic pollutants, pesticides, nutrients (nitrogen and phosphorus), plastics, abandoned, lost and otherwise discarded fishing gear, oil, hazardous substances, chemical munitions,[99] radioactive materials, and anthropogenic underwater noise.

61. The impacts of pollution include the formation of hypoxic zones in the oceans, where oxygen levels in surface water can no longer support life. Dead zones are linked with increasingly frequent outbreaks of harmful algal blooms, where mass mortality events of fish and marine mammals are caused by toxin build-ups owing to lower oxygen levels in their environment.[100] Seafood is also contaminated with toxins which may subsequently be transmitted to humans through consumption.[101] Through their bioaccumulation to levels that may adversely affect marine living resources and human health, marine pollutants can adversely affect productivity of stocks and international trade in seafood products.[102] Reproductive and

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[96] FAO contribution.

[97] See A/67/268.

[98] Marine Resources Assessment Group, "Fisheries and food security", FMSP Policy Brief, No. 3 (United Kingdom, Department for International Development, Fisheries Management Science Programme, 2006).

[99] Contribution of the Office for Disarmament Affairs of the Secretariat. Recent chemical weapons disarmament activities in the Syrian Arab Republic have drawn new attention to the safety and security of transport of chemical munitions and chemical agents by sea. Dumping of chemical and other munitions, lethal chemical agents, radioactive wastes are current issues of relevance being discussed in the disarmament context.

[100] See A/67/268.

[101] Contribution of the Intergovernmental Oceanographic Commission of UNESCO.

[102] Contribution of IAEA.

developmental issues, behavioural problems, diseases and cancers have been linked to chemical and other pollutants in seafood.[103]

62. *Alien species*. There has also been a considerable increase in the accidental introduction of alien species, both from shipping through ballast water and from escaped farmed species. In favourable conditions, alien species may become invasive and out-compete local marine species and result in biodiversity loss, thereby impacting local marine ecology, complex food webs, food security and human health.[104] Genetic interactions between escaped farmed species, including possibly those that have been genetically modified, and wild fish populations may also affect the health and productivity of wild stocks.[105] Contamination of wild fish stocks, including from parasites and disease transmitted from farmed species to wild species,[106] can also create a significant source of food insecurity or even a public health hazard.[107]

63. *Climate change and ocean acidification*. The atmosphere and oceans have warmed, sea level is rising, and the concentrations of greenhouse gases have increased.[108] The ocean has absorbed about 30 per cent of the emitted anthropogenic carbon dioxide, causing ocean acidification.[109] Although ocean acidification and climate change are separate phenomena, increased levels of CO_2 in the atmosphere contribute to both.[110]

64. Global climate change is expected to alter terrestrial inputs to the sea, the production of organic matter in the ocean, marine ecosystem composition and trophic interactions, the ice forming and melting dynamic, as well as the release of methane from permafrost areas in the Arctic, accelerating the green-house effect. As

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[103] T. Colborn, F. S. vom Saal and A. M. Soto, "Developmental effects of endocrine-disrupting chemicals in wildlife and humans", *Environmental Health Perspectives*, vol. 101, No. 5 (October 1993); L. S. Birnbaum, "Endocrine effects of prenatal exposure to PCBs, dioxins, and other xenobiotics: implications for policy and future research", *Environmental Health Perspectives*, vol. 102, No. 8 (August 1994); J. G. Vos and others, "Health effects of endocrine-disrupting chemicals on wildlife, with special reference to the European situation", *Critical Review in Toxicology*, vol. 30, No. 1 (2000), pp. 71-133.

[104] See A/67/268.

[105] William M. Muir and Richard D. Howard, "Possible ecological risks of transgenic organism release when transgenes affect mating success: sexual selection and the Trojan gene hypothesis", *Proceedings of the National Academy of Sciences*, vol. 96, No. 24 (23 November 1999), pp. 13853-13856.

[106] Albert G. J. Tacon, Marc Metian and Sena S. De Silva, "Climate change, food security and aquaculture: policy implications for ensuring the continued green growth and sustainable development of a much needed food sector". Available from www.oecd.org/greengrowth/fisheries/45044794.pdf.

[107] Contribution of the United Nations University.

[108] Intergovernmental Panel on Climate Change, "Summary for policymakers" in *Climate Change 2013: The Physical Science Basis -- Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, T. F. Stocker and others, eds. (Cambridge, Cambridge University Press, 2013), p. 4.

[109] Ibid., p. 11. See also *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, Summary for Policymakers, Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, p. 16.

[110] See A/68/159, para. 10. For information on the socioeconomic impacts of ocean acidification see A/68/71, paras. 33-39.

a result, the chemical composition of the organic matter may change accordingly with unknown consequences for global fish stocks.[111]

65. Fisheries (both capture and aquaculture) and resulting food security are closely linked to weather and climate conditions. Extreme weather and long-term climate change pose important challenges to fisheries and food security. Owing to projected climate change by the mid-twenty-first century and beyond, global marine species redistribution and marine biodiversity reduction in regions sensitive to climate change will challenge the sustained provision of fisheries productivity and other ecosystem services.[112] Fishers, fish farmers and coastal inhabitants will bear the full force of these impacts through less stable livelihoods, changes in the availability and quality of fish for food, and rising risks to their health, safety and homes.[113]

66. The implications of climate change for food security and livelihood are of particular concern in developing countries, including small island developing States,[114] where undernourishment is already widespread and reliance on seafood as a source of food is high. Redistribution of marine fisheries catch potential towards higher latitudes poses risk of reduced supplies, income and employment in tropical countries, with potential implications for food security. Spatial shifts of marine species owing to projected warming will cause high-latitude invasions and high local extinction rates in the tropics and semi-enclosed seas. Species richness and fisheries catch potential are projected to increase, on average, at middle and high latitudes and decrease at tropical latitudes. This is shown by model projections for the years 2040 to 2060, based on evidence from the Global Ocean Observing System coordinated by the Intergovernmental Oceanographic Commission of UNESCO.[115] Moreover, effects of climate change on land-based food sources could also create increased reliance and pressure on seafood.[116]

67. In light of these pressures on fisheries and aquaculture, the question of how to meet increasing demand for fish in the face of climate change will increasingly pose a great challenge to fisheries and aquaculture management.[117] In fact, increasing climate variability will make fisheries management and the forecasts of fisheries production more difficult.[118]

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[111] Contribution of IAEA.

[112] Contribution of WMO. See also *Climate Change 2014*, note 109 above, p. 16.

[113] Contribution of FAO.

[114] Ibid.

[115] Contribution of the Intergovernmental Oceanographic Commission of UNESCO.

[116] Ibid.

[117] C. De Young and others, "Building resilience for adaptation to climate change in the fisheries and aquaculture sector", in *Building Resilience for Adaptation to Climate Change in the Agriculture Sector: Proceedings of a Joint FAO/OECD Workshop, 23-24 April 2012*, A. Meybeck and others, eds. (Rome, FAO and Organization for Economic Cooperation and Development, 2012).

[118] Contribution of WMO.

IV. Opportunities for, and challenges to, the future role of seafood in global food security

A. Current activities and initiatives to ensure the continued role of seafood in global food security

68. A wide range of ongoing activities and initiatives are being taken by the international community to address the pressures described in section III above, including through strengthening implementation of the international legal and policy framework, protecting and restoring the health, productivity and resilience of marine ecosystems, enhancing the conservation and sustainable use of marine living resources and capacity-building and the transfer of technology.[119]

69. The international legal and policy framework relevant to the role of seafood in global food security is drawn from a variety of binding and non-binding instruments. Of central importance among the binding instruments is the United Nations Convention on the Law of the Sea, which sets out the legal framework within which all activities in the oceans and seas must be carried out, including in relation to seafood and its role in global food security. The Convention contains detailed rights and obligations of States including regarding the equitable and efficient utilization of their resources, the conservation of living resources and the study, protection and preservation of the marine environment.

70. The legal regime in the Convention is complemented by two implementing agreements, including the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, as well as a wide range of other instruments[120] relating to the conservation and management of marine living resources, the protection and preservation of the marine environment, sustainable development, food security[121] and human rights.[122] Together they provide the international legal and policy framework for the role of seafood in global food security.

71. National legal and policy frameworks are also vital to improving food security and ensuring the role of seafood in global food security. Given the wide variety of

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[119] Past reports of the Secretary-General on oceans and the law of the sea have provided information on past activities and initiatives (see www.un.org/Depts/los).

[120] Ibid. Additional information on the legal framework for oceans and the law of the sea is set out in past reports of the Secretary-General.

[121] For example, the 1995 Kyoto Declaration and Plan of Action on the Sustainable Contribution of Fisheries to Food Security (E/CN.17/1996/29, annex), 1996 Rome Declaration on World Food Security, 2004 Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security (E/CN.4/2005/131, annex), and the 2012 Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security of the Committee on World Food Security of FAO (FAO document CL 144/9 (C 2013/20), appendix D).

[122] For example, article 25 of the 1948 Universal Declaration of Human Rights (General Assembly resolution 217 A (III)) and article 11 of the International Covenant on Economic, Social and Cultural Rights (General Assembly resolution 2200 A (XXI), annex). See also the interim report of the Special Rapporteur on the right to food (A/68/288).

relevant international instruments, however, States are faced with challenges in incorporating their commitments in national legal frameworks.[123]

72. The following sections, inter alia, provide information on initiatives and activities described in the contributions to the present report (see para. 4 above).

1. Protecting and restoring the health, productivity and resilience of marine ecosystems

73. In the outcome document of the United Nations Conference on Sustainable Development, States committed themselves to protect and restore the health, productivity and resilience of oceans and marine ecosystems, to maintain their biodiversity, enabling their conservation and sustainable use for present and future generations, and to effectively apply an ecosystem approach and the precautionary approach in the management, in accordance with international law, of activities having an impact on the marine environment, to deliver on all three dimensions of sustainable development.[124] Many other forums have also recognized the importance to food security of healthy and productive ecosystems, as indicated below.[125]

74. *Increasing scientific understanding*. Good supporting science and data, which increase understanding of the biology and ecology of species and the key linkages among species,[126] are an essential underpinning for managing the health and resilience of marine ecosystems and food security.

75. The first global integrated marine assessment of the state of the marine environment of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, to be completed by 2014, will provide the international community with a sound, scientific basis for decision-making. It will include assessments on food security and food safety.

76. A number of recent initiatives have also focused on assessing the impacts of ocean acidification, climate change and weather events on marine ecosystems. For example, IAEA is using nuclear and isotopic techniques to assess the effects of ocean acidification, increasing water temperatures and co-contaminants on marine organisms.[127] It also expanded its support for collaborations among international researchers on the effects of rising acidity of ocean water.[128] IAEA recently initiated a four-year coordinated research project focused on key ocean ecosystems south of

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[123] The Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs of the Secretariat assists States in the uniform and consistent application of the provisions of the United Nations Convention on the Law of the Sea and its implementing agreements. It also maintains a collection of national legislation on maritime space on its website (www.un.org/Depts/los). FAO reported that it maintains a number of legal databases (http://faolex.fao.org/, http://faolex.fao.org/fishery/ and www.fao.org/fishery/psm/collection/en).

[124] General Assembly resolution 66/288, annex, para. 158.

[125] See 1995 Kyoto Declaration and Plan of Action on the Sustainable Contribution of Fisheries to Food Security (E/CN.17/1996/29, annex); Committee on World Food Security, Global Strategic Framework for Food Security and Nutrition, CFS 2012/39/5 Add.1/Rev.1.

[126] J. Travis and others, "Integrating the invisible fabric of nature into fisheries management", *Proceedings of the National Academy of Sciences*, vol. 111, No. 2 (14 January 2014).

[127] Contribution of IAEA.

[128] Ibid.; see also www.iaea.org/ocean-acidification/download/ebook-ECONOMICS%20OF%20OCEAN%20ACIDIFICATION.pdf.

30°N latitude to evaluate potential biological and socioeconomic impacts of ocean acidification and the implications for sustainable food security.

77. WMO, in partnership with the Secretariat of the Pacific Regional Environment Programme, is organizing a regional consultation on the Global Framework for Climate Services for small island developing States in the Pacific to address weather, climate and water events and climate change effects that have an impact on the socioeconomic development of those States, including fisheries.[129]

78. The North Pacific Anadromous Fish Commission encourages international cooperative research to provide the best available scientific information on ecological mechanisms regulating production of anadromous populations, climate impact on salmon populations in the North Pacific and the extent to which salmon populations can be used as indicators of conditions in marine ecosystems.[130]

79. *Integrated management and ecosystems approaches*. Increased emphasis is being placed on adopting integrated management and ecosystem approaches. Many initiatives adopt a suite of management tools in an integrated, cross-sectoral manner, including environmental impact assessments, area-based management tools, including marine protected areas and marine spatial planning,[131] management of land-sea interactions, watershed and catchment planning and management,[132] gear restrictions[133] and promotion of cleaner production and environmentally sound technologies,[134] as well as pollution prevention and control.[135]

80. Ecosystem approaches are also increasingly being implemented and promoted within sectors, in particular, the fisheries sector. Cooperation is also currently taking place to improve policy integration in ecosystem approaches between the fisheries and biodiversity sectors. For example, the Conference of the Parties to the Convention on Biological Diversity at its eleventh meeting, held in Hyderabad, India, from 8 to 19 October 2012, adopted decision XI/18 (see UNEP/CBD/COP/11/35, annex I), in which it encouraged inter-agency collaboration between biodiversity and fisheries bodies and the participation by a range of experts on biodiversity, indigenous and local communities in fisheries management, and invited fisheries management bodies to integrate biodiversity considerations into their work.[136]

81. The Partnerships in Environmental Management for the Seas of East Asia developed and implemented a multi-faceted, comprehensive, ecosystem-based approach. Its Sustainable Development of Coastal Areas Framework calls for the creation of food security and sustainable livelihood programmes to directly address

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[129] See http://gfcs-climate.org/content/regional-consultation-gfcs-small-island-developing-states-pacific.

[130] Contribution of the North Pacific Anadromous Fish Commission; the next International Symposium on Pacific Salmon and Steelhead Production in a Changing Climate is scheduled for May 2015.

[131] Contributions of the European Union and the Parliamentary Assembly of the Mediterranean.

[132] Contribution of the Partnerships in Environmental Management for the Seas of East Asia.

[133] Ibid.

[134] Contribution of UNIDO.

[135] Contributions of the Partnerships in Environmental Management for the Seas of East Asia and FAO. With regard to adapting to, and mitigating, the impacts of ocean acidification, see A/68/71 and A/68/159.

[136] Contribution of the secretariat of the Convention on Biological Diversity.

fisheries concerns in the context of other programmes that also support fisheries management, including habitat protection and restoration, management of water use and supply, pollution reduction and waste management and natural and manmade hazard prevention.[137]

82. The Intergovernmental Oceanographic Commission of UNESCO and partners are supporting the development, with coastal States, of strategies for assessing, managing, recovering, and sustaining marine living resources in large marine ecosystems.[138]

2. Promoting sustainable fisheries and aquaculture

83. A wide range of activities and initiatives is being undertaken to promote sustainability in the capture fisheries and aquaculture sectors. Increasing emphasis has been placed on incorporating integrated and ecosystems approaches in the management of fisheries and aquaculture operations.[139]

84. Despite these efforts, however, the international community has thus far been largely unsuccessful in reversing the trend of overfishing and habitat degradation.[140] In many parts of the world, economic growth in fisheries and aquaculture has only been accomplished through unsustainable exploitation of marine resources.[141]

85. At the United Nations Conference on Sustainable Development, States committed themselves to ensuring the exploitation of marine biological resources at rates which maintain or restore populations of harvested stocks at least to levels that can produce the maximum sustainable yield by 2015. States have also been called upon by the General Assembly to take a number of actions to achieve sustainable fisheries, including to urgently reduce the fishing capacity of the world's fishing fleets to levels commensurate with the sustainability of fish, to eliminate subsidies that contribute to overfishing and overcapacity and illegal, unreported and unregulated fishing and to strengthen fisheries management capacities and institutions.[142] The Strategic Plan for Biodiversity 2011-2020 and especially Aichi Biodiversity Target 6, also aims to ensure that, by 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches.[143]

86. IAEA underlined the relevance of its isotopic and nuclear data to management decisions in areas such as fisheries closures/reopenings, choice of aquaculture species and the geographical seating of aquaculture facilities, and also potentially to risk assessments of contaminants in seafood.[144] The International Coral Reef Initiative is working to improve awareness and understanding of the importance of fish aggregations for food security.[145]

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[137] Contribution of the Partnerships in Environmental Management for the Seas of East Asia.
[138] Contribution of the Intergovernmental Oceanographic Commission of UNESCO.
[139] Contribution of the Parliamentary Assembly of the Mediterranean.
[140] Contribution of FAO.
[141] Ibid.
[142] General Assembly resolution 68/71, paras. 86 and 91.
[143] Contribution of the secretariat of the Convention on Biological Diversity.
[144] Contribution of IAEA.
[145] Contribution of the International Coral Reef Initiative.

87. The European Union reported that its Common Fisheries Policy aimed to ensure that fisheries were environmentally, economically and socially sustainable in accordance with principles of good governance, including decision-making based on best available scientific advice and the precautionary principle and broad stakeholder involvement. New rules that took effect on 1 January 2014 implement the commitment undertaken at the United Nations Conference on Sustainable Development and contain measures to reduce unwanted catches and gradually eliminate discards, including through an obligation to land catches. The policy also foresees designating areas that are biologically sensitive as protected areas. The new external dimension of the reformed Common Fisheries Policy also strengthens its commitment to addressing fishing overcapacity at a global level.[146]

88. FAO highlighted that low impact and fuel efficient technologies and practices were being developed to address the energy consumption and environmental impacts of existing fishing technologies and practices.[147]

89. Regional fisheries management organizations reported on measures to improve the conservation and management of fish stocks and to contribute, directly or indirectly, to global food security.[148] For example, the secretariat of the Convention on the Conservation of Antarctic Marine Living Resources has contributed to global food security through management responses based on precaution and an ecosystems approach, including catch limits, by-catch mitigation practices, temporal and spatial closures, prohibited fishing gears and sustained efforts over more than 15 years to combat illegal, unreported and unregulated fishing.[149]

90. FAO has continued to develop its programme to support implementation of the 2009 Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing of FAO, including through its global series of regional capacity-development workshops.[150]

91. With regard to small-scale fisheries, FAO is currently facilitating the development of voluntary guidelines for securing sustainable small-scale fisheries that extend beyond the traditional realm of fisheries management and address crucial socioeconomic issues. The guidelines seek to enhance the contribution of small-scale fisheries to poverty alleviation, food and nutrition security and economic growth.[151]

92. The Sub-Committee on Aquaculture of the Committee on Fisheries of FAO is addressing a wide range of issues relating to the role of aquaculture in global food security and improving its sustainability.[152] FAO is developing the Global

[146] Contribution of the European Union.

[147] Contribution of FAO; P. Surronen and others, note 83 above, pp. 135-146.

[148] Contribution of the secretariat of the Convention on the Conservation of Antarctic Marine Living Resources, the International Commission for the Conservation of Atlantic Tunas, the North Atlantic Salmon Conservation Organization, the North East Atlantic Fisheries Commission and the North Pacific Anadromous Fish Commission.

[149] Contribution of the secretariat of the Convention on the Conservation of Antarctic Marine Living Resources.

[150] Contribution of FAO.

[151] Ibid.

[152] See FAO document COFI:AQ/VII/2013/1.

Aquaculture Advancement Programme aimed at assisting States and civil society in making future aquaculture growth sustainable.[153]

93. The International Council for the Exploration of the Sea has made aquaculture an area of strategic importance; its newly established working group on aquaculture will develop science and advice for aquaculture sustainability, addressing issues such as sea lice, pest and predator management, climate change and impacts on wild species and fisheries.[154]

94. Recent attention has also focused on the development of ecolabelling and certification programmes to strengthen sustainability measures for aquaculture through market-based incentives.[155] In this regard, FAO is currently undertaking work to assess the conformity of aquaculture certification schemes with aquaculture certification guidelines.[156]

95. FAO has also recently published a new technical paper that summarizes some of the issues facing aquaculture employment governance in a number of countries, current best practices and suggestions for improvements.[157]

96. The Common Fisheries Policy of the European Union gives a prominent role to the development of environmentally, socially and economically sustainable aquaculture and aims to promote aquaculture through an open method of coordination.[158]

3. Capacity-building and technology transfer

97. The importance of human, institutional and systemic capacity for the sustainable management of the marine environment and marine resources cannot be overemphasized and is essential to unlocking the benefits of seafood for global food security.[159]

98. In General Assembly resolutions on oceans and the law of the sea and sustainable fisheries[160] and in "The future we want",[161] States have reiterated the importance of human resource development, exchange of experiences and expertise, knowledge transfer, technical assistance, and the need to strengthen technical and scientific cooperation. Regional meetings held in preparation for the Third International Conference on Small Island Developing States have also highlighted the importance of strengthening national statistical and information systems, analytical capabilities for decision-making, and monitoring and evaluation systems for sustainable development.[162]

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[153] See FAO document COFI:AQ/VII/2013/9 and FAO, note 13 above.

[154] Contribution of the International Council for the Exploration of the Sea.

[155] See, for example, the schemes proposed by the Aquaculture Stewardship Council (www.asc-aqua.org).

[156] FAO document COFI:AQ/VII/2013/1.

[157] N. Hishamunda and others, *Improving Governance of Aquaculture Employment: A Global Assessment*, FAO Fisheries and Aquaculture Technical Paper, No. 575 (Rome, FAO, 2014).

[158] Contribution of the European Union.

[159] See A/57/57, paras. 571-639; A/57/80, part B, paras. 52-59. On the role of fisheries in sustainable development, see A/60/63, paras. 168-231 and A/60/99.

[160] Resolutions 68/70 and 68/71.

[161] General Assembly resolution 66/288, annex, paras. 160 and 277.

[162] See www.sids2014.org/content/documents/251inter-regional%20synthesis%20for%20sids2014.pdf.

99. Presented below are some initiatives and activities on capacity-building and transfer of technology that were highlighted in the contributions to the present report.

100. The secretariat of the Convention on Biological Diversity highlighted the 2010 Sustainable Ocean Initiative, which builds partnerships and enhances capacity, including in global food security, through the achievement of the Aichi Biodiversity Targets.

101. IAEA supports capacity-building for addressing ocean acidification, harmful algal blooms, pollutants, such as heavy metals and persistent organic pollutants, and uncontrolled releases of radioactivity.[163]

102. The FAO SmartFish Programme is increasing capacities for the sustainable exploitation of fisheries resources with the goal of improving fisheries policies and legal and regulatory frameworks and the quality of information systems.[164]

103. The United Nations University Fisheries Training Programme aims to strengthen institutional capacity to support the sustainable use of living aquatic resources in developing countries, with a focus on Africa and small island developing States.[165] The Western and Central Pacific Fisheries Commission has developed a project on capacity-building in fisheries statistics, regulations and enforcement for small island developing States.[166] The need to build capacity in small island developing States for negotiating trade and partnership agreements and navigating the complex requirements for accessing certain funds has also been identified.[167]

104. The European Union provides financial and technical support for the sustainable development of the fisheries sector of partner countries through fisheries partnership agreements. Regional programmes of the European Union in Africa, the Indian Ocean and the Pacific Ocean have focused on strategic governance issues, including control, surveillance and the fight against illegal, unreported and unregulated fishing.[168]

105. The World Bank's tsunami livelihood recovery project has trained fishing families along the coast of Somalia in new fishing techniques and creating better storage and refrigeration systems.[169]

B. The future role of seafood in global food security: challenges and opportunities

106. If seafood is to continue to play a critical role in food security and nutrition and in providing for the livelihoods of millions of people, greater efforts are needed

[163] Contribution of IAEA.

[164] See www.fao.org/fishery/smartfish/en.

[165] Contribution of the United Nations University Fisheries Training Programme.

[166] Contribution of the Western and Central Pacific Fisheries Commission.

[167] See para. 15 of the synthesis report of the three regional meetings held in preparation for the Third International Conference on Small Island Developing States, available from www.sids2014.org/content/documents/251inter-regional%20synthesis%20for%20sids2014.pdf.

[168] Contribution of the European Union.

[169] See www.worldbank.org/en/news/feature/2013/10/09/a-fisheries-project-on-somalia-s-eastern-coast-helps-fight-hunger-and-poverty.

at all levels. On the broadest level, fisheries and aquaculture need to be promoted in a way that improves food security and is economically viable, while at the same time conserves marine biodiversity and ecosystems and does not impair the natural ecological processes that support food production systems.[170]

107. The level of contribution of seafood to food security depends principally on maintaining healthy, productive and resilient ecosystems, on the sustainable management of capture fisheries and aquaculture, and on minimizing wasteful practices during harvesting, processing, transportation and, eventually, access for consumption. Each of these elements, however, requires appropriate levels of human, institutional and systemic capacity. In this regard, food security is directly affected by lack of capacity in every aspect of the seafood supply chain. Ongoing transfer of technologies with respect to equipment and practices used for monitoring, assessment, pollution control and clean-up, as well as for finding, harvesting, handling, processing and distributing seafood are also critical.[171] The capacity of institutions forming the components of the seafood sector would also need to be reinforced along the entire chain, from the management of the resource to its consumption. Harmonized sectoral approaches can lead to enhanced capacity at the systemic and individual levels and promote integrated management.

1. Management approaches to human activities that affect the productivity of marine ecosystems and the safety of seafood

108. While there is a comprehensive international legislative and policy framework in place for sustainable fisheries and aquaculture (see paras. 69-71 above), effective implementation remains a challenge. Incentives and adequate resources are needed to adapt and implement this framework to secure political commitment and governance reform, including by building effective institutions that lead to the adoption of integrated and ecosystem approaches to fisheries and aquaculture with fair and responsible tenure systems.[172]

109. *Cross-sectoral cooperation and coordination in integrated and ecosystem approaches*. In light of the interaction between the impacts of various activities and phenomena in the oceans and their cumulative effect on the health, productivity and resilience of marine ecosystems, the development of cross-sectoral cooperation and coordination in policy development, management and science would be a necessary step in the further implementation of integrated and ecosystem approaches in support of the role of seafood in global food security.

110. The General Assembly has repeatedly emphasized the need to consider ocean space as a whole through an integrated, interdisciplinary and intersectoral approach and to improve cooperation and coordination at all levels to support and supplement the efforts of States in the implementation and observance of the United Nations Convention on the Law of the Sea, and the integrated management and sustainable development of the oceans and seas.[173] It has also recognized the need to further integrate ecosystem approaches into fisheries conservation and management and,

[170] General Assembly resolution 66/288, annex, para. 111.

[171] FAO Fisheries and Aquaculture Department, "Sustainable technology transfer" (www.fao.org/fishery/topic/13301/en).

[172] Contribution of FAO.

[173] See, for example, General Assembly resolution 68/70, preamble.

more generally, the importance of applying ecosystem approaches to the management of human activities in the ocean.[174]

111. These approaches are particularly important as the impacts of increased CO_2 emissions compound the effects of other causes of ecosystem degradation. There is, however, no one-size-fits-all approach and such tools need to be tailored to the specific ecological, social and economic circumstances of a particular area.[175]

112. Integrated and ecosystem approaches can minimize the impacts of exploitation of marine living resources on associated ecosystems and habitats, thereby preserving their long-term viability, as well as minimizing the impact of other stressors on fisheries and aquaculture operations.[176] However, increased efforts are needed in the development of long-term management plans for fisheries and aquaculture that take into account the marine ecosystem, optimal fishing capacity and integrated frameworks of cooperation and governance.[177] FAO noted that most regional fisheries bodies are struggling to fulfil their mandates, and need greater recognition and support from the international community.[178] The North Pacific Anadromous Fish Commission suggested that a combined database on vessels engaged in illegal, unreported and unregulated fishing could supply information on a global scale, appropriate to the degree to which intelligence exchange is required to combat such activities. In that regard, capacity-building and enabling mechanisms to support cooperation and consultation on issues related to conservation and management of marine living resources are needed.[179]

113. Progress could also be made in the development of market instruments, such as eco-labelling certification schemes, to inform the purchasing decisions of consumers and the procurement policies of retailers, including the relatively new practice of issuing government-sponsored national eco-labels.[180]

114. Management approaches will also need to take into account the impact of climate change on the role of seafood in global food security. There needs to be strengthened linkages between science and policy. Greater efforts are also needed in the development of specific adaptation and mitigation measures for fisheries and aquaculture that improve the resilience of marine ecosystems, respond to opportunities for and threats to food and livelihood security due to climate change, and help the fisheries and aquaculture sector reduce greenhouse gas emissions and support the ocean's natural carbon sequestration and storage capabilities.[181] For example, in the Pacific, specific measures are being taken to support food security while also adapting to, and mitigating the impacts of, increased CO_2 emissions, including managing and restoring vegetation to reduce transfer of sediments and nutrients to coasts and prevent damage to coral reefs, mangroves and sea-grasses supporting coastal fisheries; protecting coral reefs supplying recruits to fish

[174] See, for example, General Assembly resolution 68/71, preamble.

[175] Following the seventh meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea in 2006, the discussions of which focused on ecosystem approaches and oceans, the General Assembly has consistently reaffirmed paragraph 119 of resolution 61/222 of 20 December 2006 regarding ecosystem approaches and oceans.

[176] Contribution of the Parliamentary Assembly of the Mediterranean.

[177] Ibid.

[178] Contribution of FAO.

[179] Contribution of the North Pacific Anadromous Fish Commission.

[180] Contribution of FAO.

[181] Ibid.

populations on "downstream" reefs to help stocks recover after coral bleaching or cyclones; and promoting mangrove replanting programmes to enhance habitat for coastal fisheries and capture carbon.[182]

115. Cooperation among States in addressing other human activities that adversely affect the productivity of marine ecosystems and the safety of seafood is also very important. Many measures have been adopted to address various pressures (see sect. IV.A above), but implementation needs to be strengthened, including through capacity-building.

116. *Community-based management*. The involvement of coastal communities and resource users in planning and management[183] is also a critical element of successful ecosystem approaches, given the role that humans have within marine ecosystems. Indigenous and local communities often possess traditional knowledge, innovations and practices that have global importance for conservation and sustainable use of marine biodiversity and resources.[184]

117. Initiatives and activities in co-management and/or community-driven marine management that recognize community rights to resources and provide for sustainable uses that benefit community livelihoods and well-being are likely to increase community ownership of conservation and management initiatives, and thus their sustainability in the long term, and thereby contribute to future food security at the local level.[185] Capacity-building is required to support general awareness raising within fishing communities.[186]

2. Potential roles of small-scale fisheries and aquaculture in global food security

118. *Small-scale fisheries*. Despite their importance, many small-scale fishing communities continue to be marginalized and their contribution to food security and nutrition, poverty eradication, equitable development and sustainable resource utilization has not been fully realized.[187] Particular attention must be paid to the capacity of small-scale fisheries and marginalized groups, including women fish workers and indigenous peoples, as seafood is a significant component of their food security.[188]

119. Adopting a community-based approach to development (see paras. 116 and 117 above) could be one way to create an enabling environment to reduce current vulnerabilities and allow the small-scale fisheries sector to unfold its full potential.

120. Given the importance of small-scale producers for national food security, greater efforts are needed to protect the tenure rights of small-scale producers. In this regard, the 2012 Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security of

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[182] Secretariat of the Pacific Community, "Coastal fisheries and climate change", Policy Brief 16/2012. Available from www.spc.int/coastfish/en/publications/brochures/policy-briefs.html.

[183] Contribution of the European Union, FAO and the Parliamentary Assembly of the Mediterranean.

[184] United Nations Environment Programme, document UNEP/CBD/SBSTTA/14/INF/6.

[185] Ibid.

[186] Ibid.

[187] See Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication (FAO document TC-SSF/2014/2).

[188] See www.un.org/depts/los/consultative_process/documents/adv_uned_mat.pdf, para. 118.

the Committee on World Food Security have the overarching goal of achieving food security for all and supporting the progressive realization of the right to adequate food in the context of national food security. They represent an unprecedented global consensus on responsible principles and practices for governing access to and tenure security of rights to land, fisheries and forests.[189]

121. Artisanal fisheries also suffer from high post-harvest losses because of low investment, low-level technology, variability in supply and contamination, especially during rainy periods. Coordinated international efforts to provide training and infrastructural investment for improved fish handling and processing may assist in addressing spoilage and contamination concerns.[190]

122. *Aquaculture*. The potential contribution of aquaculture to food security cannot be fully realized without consistent, responsible policies and goals, effective institutional arrangements and regulatory frameworks and improved cooperation among stakeholders at national, regional and interregional levels.[191] Despite having achieved good progress in terms of expansion, intensification and diversification, aquaculture has not grown evenly around the world (see para. 44 above).[192]

123. The aquaculture sector is relatively underdeveloped in terms of human and technical resources. Marked intraregional and interregional and country variations continue in a number of areas, such as production level, species composition, farming systems and producer profile, which have given rise to key issues and challenges that need to be proactively addressed in order to achieve the aquaculture sector's goal of sustainable and equitable development.[193]

124. In terms of increasing production, meeting the future demand for food from aquaculture will depend in part on the availability of quality feeds in requisite quantities. Considering the past trends and current predictions, the sustainability of the aquaculture sector will probably be closely linked with the sustained supply of terrestrial animal and plant proteins, oils and carbohydrates for aquafeeds, as opposed to fishmeal and fish-oil resources.[194]

125. Further efforts are also needed in strengthening international cooperation for sustainable aquaculture development. Major aquaculture development constraining factors currently include access to vital resources and technology, enhancement of capacities and institutional development, access to financial resources, especially to small farmers, climate change impacts, food safety and biosecurity risks.[195]

3. Potential innovations in seafood production

126. Throughout human history, scientific discoveries and technological innovations have repeatedly revolutionized food production methods and yields. In the seafood context, recent advances in aquaculture have enabled a dramatic growth in yields from aquaculture farms. However, the rapid growth has, in some cases, resulted in environmental damage to the very ecosystems which support aquaculture

[189] Contribution of FAO.
[190] Contribution of the United Nations University Fisheries Training Programme.
[191] Contribution of FAO.
[192] See FAO, note 13 above.
[193] Ibid.
[194] Contribution of the United Nations University.
[195] See FAO, note 13 above.

and affected the sustainability of such growth. Potential innovations in seafood production, of which three examples are provided below, may provide opportunities for enhancing the role of seafood in global food security, but may involve considerable challenges. A precautionary approach is therefore needed.

127. *Algae*. In considering the future role of seafood in global food security, the role and potential profitability of algae cannot be overlooked. As noted in paragraph 47 above, carrageenan seaweed farming is a profitable activity with great potential especially for coastal communities with abundant labour.

128. An extrapolation from current brown kelp production in China estimated that less than 1 per cent of ocean area would be required to produce 6 billion tons of algal biomass, notably without land or freshwater, and in some locations without fertilizers.[196]

129. Biofuel production from algae,[197] which can indirectly benefit food security by freeing up land currently used for biofuel production, also continues to be of interest.[198]

130. *Biotechnology*. The development of genetically modified, or transgenic, fish has been heralded as a part of the solution to meeting global food security, particularly in the light of declining fish stocks.[199] The process involves modifications intended to increase growth rate, provide better resistance to bacterial diseases, improve nutrient use and increase tolerance to colder temperatures of fish, as well as the possibility of using transgenic fish in the biocontrol of invasive species.[200] The first transgenic animal for human consumption, a fast-growing salmon, is undergoing regulatory processes in a number of countries, with Canada approving the production of salmon eggs for commercial purposes.[201]

131. However, concerns have been raised with regard to ecological risks,[202] for example, the threat to wild fish populations that would result from the escape of transgenic fish into the environment. Even when tight controls on fish stocks are maintained, the possibility of human error and the effects of natural disasters have

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[196] Six billion tons was the amount of plant matter consumed in 2013. See J. Forster, "A review of opportunities, technical constraints and future needs of offshore mariculture — temperate waters", in *Expanding Mariculture Farther Offshore: Technical, Environmental, Spatial and Governance Challenges — FAO Technical Workshop, 22-25 March 2010, Orbetello, Italy*, A. Lovatelli, J. Aguilar-Manjarrez and D. Soto, eds., FAO Fisheries and Aquaculture Proceedings, No. 24 (Rome, FAO, 2013), pp. 77-99.

[197] Noted in A/67/79, para. 23; A/66/70/Add.2, paras. 119 and 166; A/66/70, para. 63; and A/64/66/Add.1, para. 159).

[198] A. Lovatelli, J. Aguilar-Manjarrez and D. Soto, eds., *Expanding Mariculture Farther Offshore: Technical, Environmental, Spatial and Governance Challenges — FAO Technical Workshop, 22-25 March 2010, Orbetello, Italy*, FAO Fisheries and Aquaculture Proceedings, No. 24 (Rome, FAO, 2013), annex 1, sect. 4.1.

[199] Views differ as to the estimated value of such species (see "TST issues brief: oceans and seas", available from http://sustainabledevelopment.un.org/content/documents/2311TST%20Issues%20Brief%20Oceans%20and%20Seas_FINAL.pdf).

[200] W. M. Muir, "The threats and benefits of GM fish", *European Molecular Biology Organization Reports*, vol. 5, No. 7 (2004), pp. 654-659.

[201] See www.nature.com/news/transgenic-fish-wins-us-regulatory-backing-1.12130. The transgenic fish and eggs are awaiting further regulatory approval in Canada to be available for sale (http://aquabounty.com/documents/press/2013/20131125.pdf).

[202] See International Union of Nutritional Sciences (www.iuns.org/statement-on-benefits-and-risks-of-genetically-modified-foods-for-human-health-and-nutrition); also see Muir, "The threats and benefits of GM fish".

been highlighted.[203] It has been postulated that transgenic fish with greater environmental tolerances and disease resistance could expand into new environments, occupy new ecological niches affecting existing predator-prey relationships and possibly mate with wild stock, thereby modifying genes and altering wild stock.[204] Separating wild stocks would be important to maintain genetic diversity for future breeding programmes in addition to conservation and amenity values.[205]

132. With regard to the ultimate use of transgenic fish, consumer acceptance in the light of health and environmental concerns is also an issue which would need to be overcome.[206]

133. *Offshore mariculture*. Offshore mariculture is seen as offering potential to increase world food production in an environmentally sustainable way and, through its expansion, could contribute to world food security.[207] Expansion of offshore mariculture, however, faces a number of technical challenges which need to be overcome, as deeper waters are generally exposed to a greater range of wind and wave activity.[208] Possible solutions include the development of more robust mariculture architecture or mariculture systems that can be submerged to avoid wind and wave exposure.[209]

134. Offshore mariculture development has also been impeded by the relatively high production costs and the need to develop culture methodologies for species for which near-shore mariculture has not been carried out.[210] In addition, offshore mariculture systems need to address a number of operational issues, including seeding and juvenile supply, feeding, harvesting, cleaning and monitoring, especially in the potentially difficult and dangerous conditions in which the offshore mariculture systems would be deployed.[211]

135. Although progress has been noted, further development of offshore mariculture systems for fin fish, shellfish and macroalgae is needed to make them commercially viable.[212] Policy and regulatory frameworks have been called for to achieve the expansion of offshore mariculture as well as policies to facilitate the necessary technological developments.[213]

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[203] See Muir, note 201 above.

[204] Ibid.

[205] B. O. Acosta and M. V. Gupta, "The genetic improvement of farmed tilapias project: impact and lessons learned", in *Success Stories in Asian Aquaculture*, S. S. De Silva and F. B. Davy, eds. (Dordrecht, Springer, 2010), pp. 149-170; and contribution of the North Atlantic Salmon Conservation Organization.

[206] See International Union of Nutritional Sciences (www.iuns.org/statement-on-benefits-and-risks-of-genetically-modified-foods-for-human-health-and-nutrition).

[207] Mariculture has been understood as offshore "when it is located > 2 km or out of sight from the coast, in water depths > 50 m, with waves heights of 5 m or more, ocean swells, variable winds and strong ocean currents, in locations that are exposed (open sea, e.g. ≥ 180° open) and where there is a requirement for remote operations, automated feeding, and where remote monitoring of operating system may be required" (Lovatelli et al., note 199 above, p. 4).

[208] Lovatelli et al., note 199 above, annex 1, sect. 4.

[209] Ibid.

[210] Ibid., annex 1, sect. 3.3.

[211] Ibid., annex 1, sect. 4.2.

[212] Ibid., annex 1, sect. 4.2.

[213] Ibid., p. 3.

4. Mainstreaming seafood in global, regional and national measures on food security

136. Fisheries and aquaculture sectors are often overlooked in the development of food security strategies at national and international levels. In considering the future role of seafood in global food security, greater awareness is needed of the importance of incorporating or mainstreaming the fisheries and aquaculture sectors in these policy discussions.[214] Currently, policy integration appears most prominent only at the inter-agency and intersectoral levels in oceans law and policy, for example in promoting integrated and ecosystem approaches, as described above. At a minimum, it would be beneficial to create synergies between traditional management tools in the fisheries and aquaculture sectors and socioeconomic strategies.[215] Consideration could also be given to fully integrating the fisheries and aquaculture sectors into national climate change adaptation and food security policies and programmes.[216]

137. At the United Nations Conference on Sustainable Development, States supported mainstreaming the consideration of the socioeconomic impacts and benefits of the conservation and sustainable use of biodiversity and its components, as well as ecosystems, into relevant programmes and policies at all levels, in accordance with national legislation, circumstances and priorities.[217] Particular attention was drawn to the need to identify and mainstream strategies that further assist small island developing States in developing capacity to conserve, sustainably manage and realize the benefits of fisheries.[218]

138. Mainstreaming seafood in global, regional and national measures on food security will contribute to policy coordination and discussions on trade-offs in the production of seafood and other foods. As described in section II.B above, different types of seafood from different sources can contribute to food security in different ways with varied levels of effectiveness. Each type and source of seafood may also be in competition with other types and sources of seafood or other foods, thereby creating the need for policy trade-offs which should be considered in developing policy frameworks or measures for any particular sector involved in global food security. For example, capture fisheries, algae farms and aquaculture may compete for ocean space in coastal areas. Large-scale fishing operations, which are more efficient and produce greater revenue, may be in competition with small-scale and artisanal fisheries, which create greater levels of employment and are more likely to provide food for local communities. Distant water fishing fleets may provide greater

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[214] Contribution of FAO. For example, the Second International Conference on Nutrition, an inclusive intergovernmental meeting on nutrition jointly organized by FAO and the World Health Organization, in cooperation with the High-level Task Force on the Global Food Security Crisis, the International Fund for Agricultural Development, the International Food Policy Research Institute, UNESCO, UNICEF, the World Bank, WFP and the World Trade Organization, will be held at FAO headquarters in Rome from 19 to 21 November 2014 and will propose a flexible policy framework to address today's major nutrition challenges and identify priorities for enhanced international cooperation on nutrition.

[215] It has been estimated that the potential economic gain from restoring fish stocks and reducing fishing capacity to an optimal level is in the order of $50 billion per year (see World Bank and FAO, *The Sunken Billions: The Economic Justification for Fisheries Reform*).

[216] FAO, *Report of the FAO Expert Workshop on Climate Change Implications for Fisheries and Aquaculture: Rome 7-9 April 2008*, FAO Fisheries report No. 870 (Rome, 2008), p. 5.

[217] General Assembly resolution 66/288, annex, para. 201.

[218] Ibid., paras. 174 and 175.

revenue to developing States through fishing licences, but may also affect local communities who rely on local fishery resources.

139. The most appropriate course of action for resolving such trade-offs will need to be determined on a case-by-case basis, taking into account all relevant considerations. By integrating food security considerations into coastal and marine area management and planning, as well as by involving relevant stakeholders in decision-making, States could effectively explore policy options for maximizing the role of seafood and seafood industries in food security. For example, small fish discards or by-catch from fisheries which could be for human consumption could also be used to produce fishmeal destined for aquaculture.

V. Conclusions

140. Population growth in the face of the ongoing challenge of eradicating extreme poverty and hunger, as well as malnutrition, coupled with the effects of climate change, environmental degradation and other factors have given rise to concerns about global food security. Seafood plays a significant, but not yet fully recognized, role in global food security as a source of food and nutrients and as an input to food production, as well as a source of revenue. In particular, safe seafood can be a key source of protein, as well as other essential nutrients and micronutrients. Certain parts of the world, including many coastal communities in developing countries and small island developing States, are particularly reliant on seafood for food security, including nutritional aspects, livelihoods and economic well-being.

141. In terms of the future of seafood in global food security, it will be important for the international community to mainstream the role of seafood in policy discussions relating to food security at the global, regional and national levels. It will be equally important for the various sectors involved in the management of human activities that impact on oceans and their resources to consider specific measures within the broader context of food security. This, in turn, will assist policymakers in making informed decisions on how to ensure the continued contribution of seafood to food security, particularly with regard to its availability, access, utilization and stability. In this regard, decision-making processes would benefit from the informed participation of all relevant stakeholders, including coastal communities, small-scale and artisanal fishers and consumers. Co-management and/or community-driven marine management that recognize community rights to resources can be very effective in supporting seafood sustainability. Given the crucial role of women in coastal fishing communities, their capacity to engage in a productive manner in the fisheries and aquaculture sectors requires strengthening.

142. It is noted that communities living below the poverty level, in particular in developing countries, including small island developing States, face critical challenges in their efforts to ensure the availability of, access to and sustainability of seafood for food security. International cooperation and coordination is needed to assist States in addressing these challenges, including through capacity-building and transfer of technology.

143. The continued contribution of seafood to global food security will also depend on the ability of States to address, in an effective, efficient and timely manner, current pressures and challenges to seafood sustainability, including

overexploitation and unsustainable practices in seafood exploitation, marine pollution, habitat destruction, climate change and ocean acidification. It is critical to maintain healthy, productive and resilient ecosystems to support the continued contribution of seafood to food security. Integrated and ecosystems approaches that consider the oceans as a whole are important tools to that end and to sustaining the role of seafood in global food security.

144. Finally, it is important for States to take advantage of opportunities to optimize the role of seafood in global food security, including through sustainable aquaculture and small-scale fisheries, as well as responsible technological innovation.